



**Brookhaven National Laboratory**

**SNS**

**Ring and Transfer Lines Systems**

**JUNE**

**MONTHLY REPORT**

**01 June – 30 June 2002**

Performing Organization:  
Location:

Brookhaven Science Associates  
Brookhaven National Laboratory  
Upton, New York 11973-5000

Contract Period:

October 1998 – June 2006

Brookhaven National Laboratory  
SNS MONTHLY PROGRESS REPORT  
June 2002  
Ring and Transfer Lines Systems

## **I. Senior Team Leader Assessment**

### **1. TECHNICAL PROGRESS AND ACCOMPLISHMENTS**

- At the European Particle Accelerator Conference, 16 posters were presented by BNL on the design, tests, and upgrades of the SNS Ring and transport lines. 16 papers were submitted for publication.
- A laser profile monitor was successfully tested in the AGS linac with H- beam. The measured beam profiles were calibrated with those obtained with traditional wire-profile monitor. Such laser profile monitor is proposed for the superconducting RF linac of SNS.
- The first collimator (RTBT) was constructed at France and shipped directly to ORNL.
- 50% of the ring dipoles were successfully shimmed and measured to correct the large variation of magnet transfer function due to material variation among magnets of solid-steel core. The rms variation was reduced by about one order of magnitude to  $10^{-4}$ .
- Collaboration efforts continue with LBL on the study of electron-cloud accumulation in the ring. Anticipating a high electron concentration, the physics and engineering groups worked on a plan of installing clearing electrodes of high voltage at collimation section, in addition to electrodes already implemented at the injection section and BPM location around the ring.
- We are proposing to sponsor an ICFA Workshop on Beam Halo Dynamics, Diagnostics, and Collimation for May 2003. This subject is of crucial importance both to high intensity machines like SNS, JKL, and proton drivers, as well as high energy colliders like LHC.

### **2. ISSUES AND ACTIONS**

- None.

### 3. COST AND SCHEDULE STATUS

#### 3.1 VARIANCE ANALYSIS AND PROJECT COST PERFORMANCE REPORTS

##### WBS 1.1.3 R&D

###### Variance Analysis (Cumulative to date) (\$K)

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
5091.8	5091.8	5112.9	0.00	0.0%	(21.2)	-0.4%

**Variance Statement:** Cum variances are within thresholds. No analysis required.

**Project Impact:** None.

**Corrective Action:** None.

##### WBS 1.5 Ring and Transfer Lines

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
51685.0	51736.6	52598.7	51.59	0.1%	(862.0)	-1.7%

**Variance Statement:** Variances are within thresholds. No analysis required.

**Project Impact:** None.

**Corrective Action:** None

### 3.2 MILESTONE STATUS

WBS 1.5 and 1.1.3 have no level 0 milestones. Milestone status is listed below.

Milestones	Level 1	Level 2	Level 3	Level 4	Level 5
Project	0	1	3	13	127
FY02	0	0	0	0	17
Due in Next 30 days	0	0	0	0	2
Total Due at present	0	0	3	12	101
Made	0	0	3	12	89
Missed	0	0	0	0	12
Ahead of Schedule	0	0	0	0	0

### 3.3 PROJECT CRITICAL PATH ANALYSIS

The critical path items for the Ring are the Ring Sextupole magnet, followed by the BCM.

## II. Detail R&D Subproject Status

### WBS 1.1.3 – Ring System Development

All work covered by R&D funds is essentially complete.

#### **Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
5091.8	5091.8	5112.9	0.00	0.0%	(21.2)	-0.4%

**Variance Statement:** Cum Variances are within thresholds. No analysis required.

**Project Impact:** None.

**Corrective Action:** None.

### III. Detail Line Item Subproject Status

#### WBS 1.5.1 – HEBT Systems

Phone conferences continued with Tesla during the month on the HEBT dipole magnet. They are finishing long magnet number 6 and should mail it in July. A discrepancy was found in the design of the short HEBT dipole magnet – the base holes do not match the standard magnet stand. A new base hole will have to be drilled into the bottom. Phone conferences continued with Danfysik during the month. Danfysik sent the first production lot of eleven 12Q45/16CD20 magnets to ORNL on June 21.

Detail design of 12cm drift chambers continues. Purchase orders were placed for standard 12cm pump tees and foil stripper instrument tees. Fabrication of welding fixtures for 21 cm quadrupole chambers continued at a slow intermittent pace, due to a lack of welders.

Drawings of the HEBT momentum dump are complete, and are being reviewed.

#### **Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
4698.2	4366.6	4278.5	(331.62)	-7.1%	88.1	2.0%

**Variance Statement:** Variances are within thresholds. No analysis required.

**Project Impact:** None.

**Corrective Action:** None.

#### WBS 1.5.2 – Injection Systems

The requisition, SOW, Specifications, and drawings for the #2 and #3 chicane magnets and the dump septum drawings were approved. The package is out for bids and the bids are due back on July 8. The drawings for the #1 chicane magnet are being checked. Assembly of the injection septum magnet is continues. New England Technicoil shipped the #4 chicane magnet. It was received at BNL but failed inspection because of cracks and poor procedure in potting the coil. The magnet will be shipped back to NET for repair

The long kicker magnet horizontal and vertical 1<sup>st</sup> article is being moved to building 902 for magnetic measurement and testing with the power supply. (The lifting fixture passed certification testing and was used for the move.) The power supply is due in house the beginning of July. The requisition for the ferrite is being prepared but awaits final testing. Ceramaseal has finished brazing the 1<sup>st</sup> article ceramic vacuum chambers. They are doing final inspection and will ship them the beginning of July.

### **Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
3876.6	4135.9	4127.5	259.28	6.7%	8.4	0.2%

**Variance Statement:** Cum Variances are within thresholds. No analysis required.

Current period SV \$58K (34.5%) reflects BCWP recorded against material, WBS 1.5.2.2 Injection Kicker PS.

**Project Impact:** None.

**Corrective Action:** None.

### **WBS 1.5.3 – Magnet Systems**

The SNS magnet parameters spreadsheet is complete and was forwarded to ORNL for review and comment. Some confusion occurred during the month over the parameters for the 26S26 sextupole that resulted in meetings and reviews but it has been resolved and updated.

At this time there are 17 good 17D120 ring dipole magnets (ITF that is  $<1 \times 10^{-4}$  from the nominal value) that have been fully shimmed and magnetically measured. When measurements of the first 16 magnets were carefully studied, it was found that the cycling for aperture scans at 1.0 GeV was incorrect for two magnets measured early in the production testing. (The measurement was preceded by measurement of the 1.3 GeV excitation function instead of cycling to the current prescribed for the 1.0 GeV aperture scans, a lower value.) When measured with the correct 1.0 GeV cycling, results indicated that one magnet should be shimmed. This work delayed completion of measurement of the first 16 magnets (“left handed” terminal configuration) until the third week of the month. In addition, magnetic measurements of the spare have been completed. The spare will be shipped to ORNL. It took a week to switch the cables to the configuration needed for the last 16 magnets (“right handed”). In addition, time was needed to realign the arm of the main switch for the power supplies. By the end of the month, the initial measurement of the first “left hand” magnet was nearly complete. (The initial measurement is used to determine the shim.) Magnetic measurements from the first 16 ring dipoles were presented in a paper to the European Particle Accelerator Conference in early June.

Six 21Q40's were received and inspected at BNL during the month and Tesla is preparing another batch of six for shipping.

Construction of the third survey/measurement station for production measurement of the multipole high field and corrector magnets continues. Completion was slowed when it was discovered that the stand used to support the measuring coil needed to be made more rigid. By the end of the month, the alignment of the stand, measuring coil, and magnet had been completed and the checkout of the system was underway.

Magnetic measurements of the 26Q40 have been completed. A detailed analysis of the results is underway. At this time it appears some trimming of the end chamfers will be necessary. Analysis is underway to determine the location and amount of trimming required.

Production of the 21CO26 magnets was completed during the month. Three more were received during the month, tested, and inspected. All nine production magnets are now in house.

Phone conferences were held with Budker Institute of Nuclear Physics (BNIP). The first article magnet was packaged at the end of the month and prepared for air shipment to BNL.

Danfysik shipped 9 more 27CDM30's during the month. The batch of nine from last month has been stuck in customs for three weeks because of the other material in the shipping container (pet food). By the end of the month the magnets had been separated out and they will be shipped to BNL shortly.

Alpha Magnetics is doing the final assembly of the 41CDM30 1<sup>st</sup> article and they plan to ship it early in July.

#### **Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
9772.8	9636.5	10028.1	(136.25)	-1.4%	(391.6)	-4.1%

**Variance Statement:** Cum variances are within thresholds. No analysis required.

Current period (CV) -\$207.2K (-57.1%) is material driven by WBS 1.5.3.1 High Field Magnets and 1.5.3.2 Low Field Magnets. Whereas process payments have been made and hardware not delivered.

**Project Impact:** None.

**Corrective Action:** None.

#### **WBS 1.5.4 – Power Supply Systems**

Bids were received for the Main Ring Dipole RFP. A request for a Best And Final Offer (BAFO) was released, pointing out where issues needed to be resolved. The closing date for the BAFO is July 18. It is expected that we will award the contract in August.

The first Injection Kicker PS has been delivered to BNL, where it will be tested further. The contract to build the eight production units will be awarded in July.

Testing of the Extraction Kicker PS has shown the unit to be within specification. The rise time as measured from 1% to 95% is 202 nSec, and the flat-top ripple is less than +/- 1% peak to peak at full current. The contracts to purchase the thyratrons and PFN capacitors will be awarded in July. The RFQ for modulator production is to be released in July.



**Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
922.2	916.6	1002.9	(5.56)	-0.6%	(86.2)	-9.4%

**Variance Statement:** Variances are within thresholds. No analysis required.

**Project Impact:** None.

**Corrective Action:** None.

**WBS 1.5.5 – Ring Vacuum System**

Four more type-B HC chambers have been coated with TiN at lower pressure and with glow discharge cleaning before and after the coating, bringing the total coated chambers to sixteen. Five coated samples were sent to colleagues at CERN for SEY measurement. All necessary hardware for coating of ceramic chambers and RF pipes has been received. The 1<sup>st</sup> production RF cavity pipes were received from central shop and are being leak checked before setting up for TiN coating. Two more test coatings were performed on the test setup with good results. The coating test setup is being reconfigured for cavity pipes.

Several meetings were held to discuss the layout of collimation straight section including the available space, the length and the locations of the collimators and the doublet chamber aperture requirement.

A proposal from the TMP Cart vendor to improve system operation has been accepted by BNL and subsequently by LANL. A change order has been issued. Additional gauges, controllers and cables for the SNS turbo carts were ordered. All but 23 gauges of the original gauge controller order have been delivered to SNS/RATS. Support for the HEBT prototype vacuum system controls continues with successfully established communication between the ion pump and gauge controllers and the VME485 module. Work on the PLC ladder logic software, the 485 drivers for ion pump controllers and gauge controller, and the EPICS GUI continues.

A PCR to transfer the design and fabrication of the Linac and extraction dump window pipes to ORNL was submitted and approved. The cost of Ring spare straight section doublet chambers is being prepared for project office approval. A paper on the coating of the injection ceramic chambers was presented at EPAC2002.

**Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
4037.7	4439.1	4477.3	401.45	9.9%	(38.2)	-0.9%

**Variance Statement:** Cum Variances are within thresholds. No analysis required.

Current period SV \$156.8K (71.5%) % CV \$161.4K (42.9%) reflects BCWP recorded against material, WBS 1.5.5.2 Ring Vacuum Pumps and 1.5.5.3 Gate Valves; whereas actual costs have not been recorded. ACWP will be recorded in subsequent current periods.

**Project Impact:** None.

**Corrective Action:** None.

### **WBS 1.5.6 – RF System**

**HLRF:**

- Variac racks production is going well;
- PA design package is in the shops;
- Second cavity assembly is under way

**LLRF:**

- Communication between the DSP module and the IOC was successfully demonstrated for the first time. The DSP configuration registers, multi-processor memory space, SDRAM and FLASH were all accessed by the IOC.
- Preliminary development work is beginning on LLRF control applications.
- Design work has begun on the A/D daughter card. The I/Q modulator daughter card is in the design room.
- Debugging and testing of the generic carrier card continued.

### **Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
5584.7	6075.7	6006.7	490.98	8.8%	69.0	1.1%

**Variance Statement:** Cum variances are within thresholds. No analysis required. Current period CV -\$76.9K (-51.8%) reflects ACWP recorded against WBS 1.5.6.1 High Level RF Systems for material delivered in previous current period.

**Project Impact:** None.

**Corrective Action:** None.

### **WBS 1.5.7 – Ring Diagnostics**

Group members devoted considerable effort to preparation of materials for the BNL Diagnostics Design Review, scheduled for the week of July 22nd. A paper on tune measurement was presented at EPAC.

Production of BPM PUEs continues, with a total of 32 ea of 21 cm Ring and 10 ea of 21 cm HEBT delivered to the Vacuum Group. Assembly fixtures were completed for the 26 cm, 30 cm and 36 cm BPM PUEs. Continued work on wire scanner for PUE transfer function measurements. S11 and TDR measurements of SNS and RHIC (for reference) PUEs are in progress. Bergoz has sent us preliminary details of proposed baseband AFE, which we are reviewing. Production study of PCI interface for BPM and BCM systems is in progress. It appears that the recent rev B boards received from LANL have an older rev of the PGA. They respond only to falling edge triggers and do not support multiple channel data acquisition. Received the chip file for the Quicklogic PGA from LANL, but there is now concern about which rev we actually received.

Profiles were obtained from the prototype luminescence monitor installed in the AGS Ring. Focus of the effort is now shifted to the Tandem, where we are working on optics and data acquisition design with the goal of making Nitrogen cross section measurements and exploring other gases. Investigating possible rad hard in-tunnel IPM preamp solutions to provide the bandwidth needed for turn-by-turn profiles (this is an AP requirement for this system)

Tests of the new BLM chamber design were completed at the BNL Linac. Expected improved rise times were observed, data is being examined. We continue working with the three vendors who are generating manufacturing proposals for the improved ion chamber detectors. A third prototype front end circuit was stuffed and tested for thermal drift characteristics. Analysis of the VMIC 16 bit digitizer continues as the primary ADC for both digitized outputs of the AFE. The search continues for alternative digitizers.

Work continues on testing the new Bergoz BCM transformers. Continued fabricating the housing and the beam pipe of the prototype HEBT BCM (with 6"ID) in the shops. The rev 2 board stuffing has started. The Agilent 3458 DMM to be used for BCM calibration and other high precision requirements was set up, operation was verified, and it was used to test the new BCM current source. Craig Swanson, the consultant working on the timing module at Oak Ridge called to ask about our requirements. We discussed 64xFrev and 8 adjustable timing pulses. Sent information about our signal needs for the timing module to ORNL. Set up the BCM returned from Berkeley to verify the test setup for the new PCI boards from LANL.

UAL modelling of beam transfer function measurement continues to show good progress.

Cost estimates were received from LANL for HEBT, Ring, and RTBT carbon wire scanners. A letter of intent was written for transfer of this responsibility from BNL to LANL.

MEBT carbon wire scanners were received from Berkeley, and preparations to refurbish them for the September commissioning in Oak Ridge are underway. Critical path is Huntington actuator refurbishment.

Laser wire profiles were obtained at 200MeV on Father's Day, and confirmed with carbon wire measurements. Laser intensities were erratic, perhaps as a result of radiation damage. Motion control problems persisted, and ultimately it was necessary to gather the data by hand. Preparations are underway to install a SCL beambox upstream of the booster bend to permit parasitic laser wire studies during the next AGS/RHIC beam run. Intent is to use LANL BPM electronics on PUEs on either side of the beambox, to replicate as close as possible operating conditions at SCL.

Beam-in-Gap UAL simulations and vendor discussion regarding pulsters continue.

#### **Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
5586.4	5364.5	6077.5	(221.90)	-4.0%	(712.9)	-13.3%

**Variance Statement:** Cum (CV) of -\$712.9K (-13.3%) is material driven by 1.5.7.1 Ring Beam Position Monitor Sys and 1.5.7.4 Ring Beam Current Monitor, whereas BCWP for material is understated and will be adjusted in the current period. Current period SV -\$48.8K (-28.4%) is driven by 1.5.7.3 Beam Loss monitors whereas no BCWP was credited to BLM Assy and Support. Current period CV -\$70.6K (57.2%) is driven by 1.5.7.4 Ring Beam Current Monitor (BCM) whereas material BCWP is understated and will be adjusted in subsequent current period.

**Project Impact:** None.

**Corrective Action:** None.

#### **WBS 1.5.8 – Collimation and Shielding**

Work is continuing on the first scraper for the Ring. A meeting was held with instrument and controls staff to prepare an ICD covering all collimators and scrapers. The ring secondary and tertiary absorber drawings are being prepared. Finally, the vacuum chambers before and after the primary collimator are being integrated with the collimator.

Drawings of the modified shield are complete. A review is scheduled.

#### **Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
1674.2	1476.0	1477.3	(198.20)	-11.8%	(1.4)	-0.1%

**Variance Statement:** Cum schedule variance (SV) of -\$198.2K (-11.8%) is material driven by 1.5.8.1 Ring Collimator 1<sup>st</sup> delivery; whereas a PCR will be processed to show planned delivery in March '03 thus adjusting SV. Current period variances are within thresholds. No analysis required.

**Project Impact:** None.

**Corrective Action:** None.

### **WBS 1.5.9 – Extraction System**

The PFN drawings were completed, checked, and approved. They have been turned over to the pulsed power group for inclusion into their procurement package for the power supplies. The low Mu ferrite magnet is ready for the final full power test. Detailed design of the extraction kicker magnets that are downstream doublet continues. The design details include each kicker module, support, vacuum chamber, and the tooling required for installation. The impedance test set up used for extraction kicker was modified and will be used for RF cavity impedance test.

A design review of the lambertson extraction septum magnet was held on 6/17. The revised design and geometry were presented, including the introduction of magnet roll for RTBT elevation correction. There were no open issues so detailed design of the magnet continues.

#### **Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
1492.2	1440.8	1493.7	(51.40)	-3.4%	(52.9)	-3.7%

**Variance Statement:** Variances are within thresholds. No analysis required.

**Project Impact:** None

**Corrective Action:** None.

### **WBS 1.5.10 – RTBT System**

The Specification, SOW, and drawings for the 27CD30 corrector dipole magnet that is used in both the RTBT and in the HEBT line with the 21Q40 quadrupoles have been completed, checked, and approved. The requisition and bid package is being prepared. Design Review of the stand for the 21Q40/27CD30/ion pump assembly to be used in the HEBT and RTBT was held on 6/21. After addressing some minor issues, the stand drawings are being completed.

Detailing of RTBT magnet vacuum chambers and drift spaces pipes continues. Design Review was held for HEBT and RTBT 21cm quadrupole chamber ion pump stands including integral adjustments for vacuum flange alignment. An internal review of extraction Lambertson magnet and vacuum chamber was held.

The first unit has been shipped to ORNL. The final drawings of the second RTBT collimator are also complete.

**Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
2724.0	2568.8	2442.7	(155.17)	-5.7%	126.1	4.9%

**Variance Statement:** Variances are within thresholds. No analysis required.

**Project Impact:** None.

**Corrective Action:** None.

**WBS 1.5.12 – Technical Support**

- Group presented for the EPAC papers (15) and 6 people participated in the EPAC02 Conference, Paris, France.
- Optimization of primary ring collimator and beam pipes.
- Proposal of a special electrode in the collimation area for electron-cloud cleaning.
- Medium PS current were rechecked and finalized.
- Parameters of primary collimator and beam pipe were finalized.
- A special electrode in the collimator area is proposed to clean electrons for reducing the possibility electron-cloud effects.
- Studies continue for envelope instability and parametric resonances.
- Study of excitation of resonances with fringe file started.
- Group member actively participated in diagnostic issues.
- M. Blaskiewicz visited Miguel Furman at LBNL June 3 though 7. During this week Miguel's code Posinst was optimized and, for the optimization test case, the computer time was reduced by a factor of 200.
- For other runs Miguel reports a speed increase of a factor of 10. A bug was found in Mike's code NCSEC (Nearly Cylindrically Symmetric Electron Cloud). This bug caused the electron density to be underestimated and new results will be presented at ASAC.

### **Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
11315.5	11315.5	11185.8	0.00	0.0%	129.6	1.1%

**Variance Statement:** Variances are within thresholds. No analysis required.

**Project Impact:** None.

**Corrective Action:** None.

### **WBS 1.9.1 – R&D**

#### **WBS 1.9.2.2 – Global Timing**

##### **V124s**

The first article module of the contract to manufacture 50 modules has been received at BNL and is being tested. Delivery is scheduled for late July.

##### **V123s**

The V123 bug of not passing on the interrupt acknowledge has been duplicated at BNL. The latest design file sent to ORNL cleared up the problem.

##### **Eventlink fanout-**

A production order of 80 pieces is out for bids. Bids are due back in early July.

##### **V206**

The V206 documentation has been released. A production run of 16 modules is out for bids. The bids are due the second week of July.

##### **Eventlink Monitor.**

The requirements for the SNS eventlink monitor are very similar to those of RHIC. The RHIC monitor module needs to be tested at the SNS eventlink frequency of 17 MHz to determine that sufficient engineering margin exists in the receiver design. In addition, the minimum time between event transmissions is reduced as a result of the faster carrier. 13 carrier cycles are required from the start of one event to the next. At 14.37 MHz (the RHIC beam sync frequency) this means events can arrive every 904 ns. The SNS eventlink operates at ~17 MHz. Events can arrive every 764 ns. This aspect of the module architecture needs to be tested too. The RHIC module has a 256 event FIFO to provide a buffer between the arrival times of events and the time it takes to store events into RAM. Deeper pin compatible FIFOs up to 2K events deep are available, if necessary.

### **WBS 1.9.5.1 -Ring Controls Integration**

BNL hosted an EPICS training course for all controls staff. Members of the Beam Diagnostic and RF groups also attended. The deeper understanding this training provided has already led to some immediate improvements in existing controls software.

### **WBS 1.9.5.2 - Power Supply Controls**

The Yokogawa function generator and ADC hardware system has arrived, along with Windows based control software. This system will be used to test the prototype injection kicker power supply in building 902. The related documentation is nearly completely translated from Japanese, allowing work to begin on EPICS device support for the system.

A new revision of the PSI prom has been developed to shorten the recalibration time. Preliminary tests look promising, but more regression testing is needed before it can replace the previous version.

Work continues on a reference IOC, fully loaded with Power Supply Controllers, utility module, and timing decoder (V124) module, to verify memory usage and CPU loading are reasonable.

### **WBS 1.9.5.3 – Diagnostics**

New BLM electronics were tested using a 100KHz 16-bit digitizer, instead of the 24-bit digitizer that had been previously thought necessary. The result shows 16-bit digitizer is suitable for the BLM application. On July 22, there will be a ring beam diagnostics design review. Between now and then, two other 16-bit digitizers will be evaluated for performance and price. Similar tests are planned for the ring IPM system, which is also included in the July 22 review, and which requires a 10MHz, 12-bit digitizer.

Work has begun on the Beam Dump temperature monitoring system. The system will be ControlLogix PLC-based, and will have an input into the MPS system for each beam dump.

### **WBS 1.9.5.4 - Vacuum**

Following discussions with the vacuum group, priorities have shifted away from device access to ion pump and gauge controllers (despite progress made in those areas), and toward the PLC-based valve control.

In addition, the need for local control screens (based on RSVIEW) was questioned. A decision was made to provide only EPICS screens.



### **WBS 1.9.5.5 - Application Software**

Work has begun on a program for commissioning the ring LLRF system. Discussions with the RF group have resulted in preliminary design requirements.

The SPF (Standard Propagator Format) module of the UAL framework was implemented for developing configurable tracking engines (e.g. Linear Mapper or Fast Teapot). This module is a part of the bld004 release that can be downloaded and browsed from the UAL CVS repository (<http://www.ual.bnl.gov/ual-cgi-bin/cvswebual1.cgi/>)

The ORBIT application was installed on the BNL linux cluster for benchmarking the UAL collimator module.

Simulation support was provided for modeling of the tune measurement system, particularly, the Beam Transfer Function (BTF) approach presented in EPAC '02 paper "Tune measurement in the SNS ring".

### **WBS 1.9.5.6 – RF**

Work continues on supporting the Hammerhead PMC-DSP module from Bittware. Previous difficulties accessing the full memory of the DSP board have been resolved. The Bittware-provided "host interface library" can now be ported, allowing downloading of DSP programs via EPICS into DSP FLASH memory.

#### **Variance Analysis (Cumulative to date) (\$K)**

<b>BCWS</b>	<b>BCWP</b>	<b>ACWP</b>	<b>SV</b>	<b>%</b>	<b>CV</b>	<b>%</b>
4689.1	3855.9	3791.2	(833.23)	-17.8%	64.6	1.7%

**Variance Statement:** Cum schedule variance (SV) of -\$833.2K (-17.8%) is driven by 1.9.5.3 Diagnostics and 1.9.5.4 Vacuum Controls whereas the design has impacted the procure and fabrication of software. Current period SV - \$180.8K (-70.3%) is driven by 1.9.5.3 Diagnostics whereas BCWP is less than BCWS. PCR CO02003 is being processed to reconcile BCWS.

**Project Impact:** None.

**Corrective Action:** None.

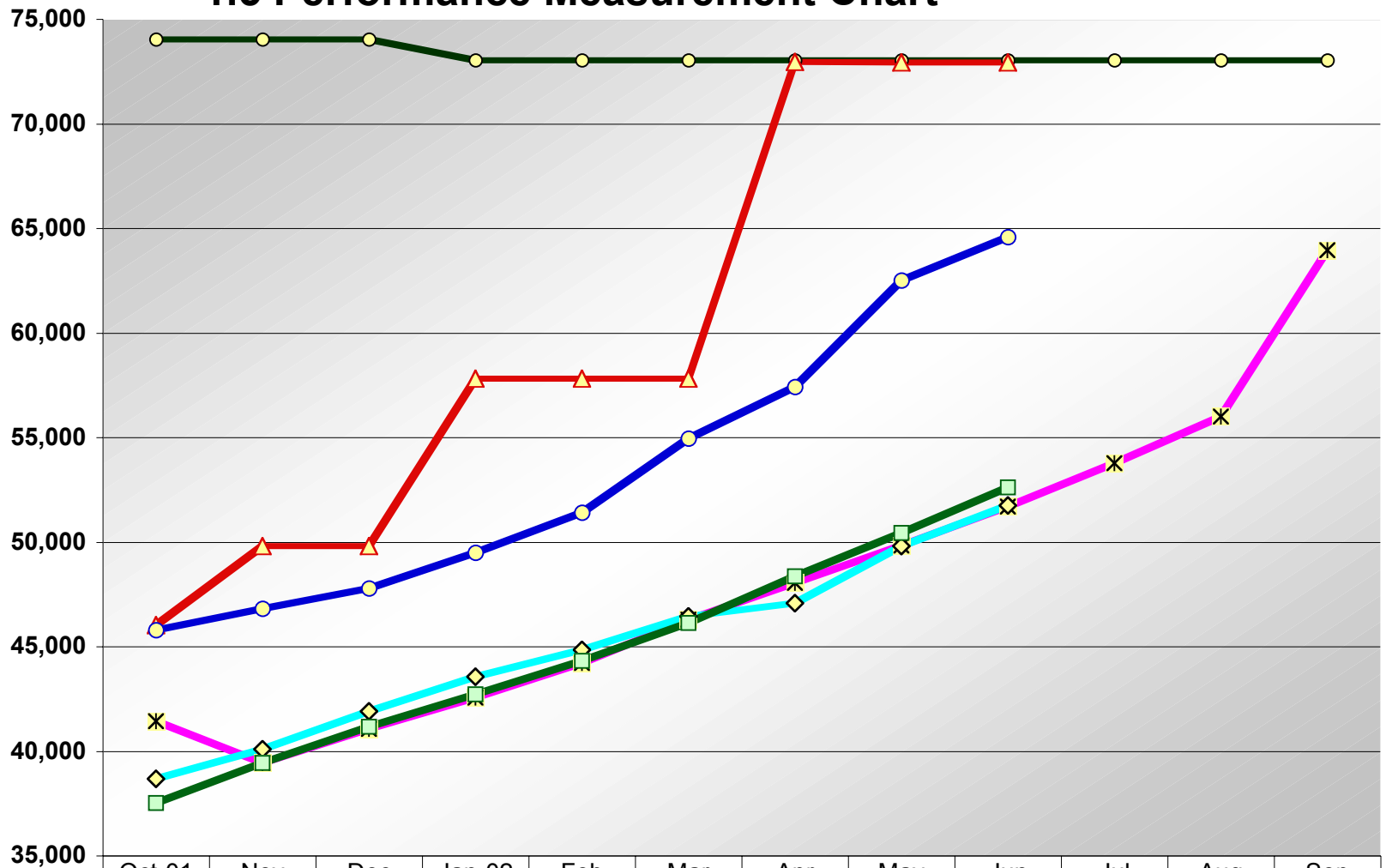
## **IV. Earned Value Reports and Charts**

**U.S. DEPARTMENT OF ENERGY  
COST PERFORMANCE REPORT - WORK BREAKDOWN STRUCTURE (FORMAT 1)**

<b>PROJECT TITLE:</b> SPALLATION NEUTRON SOURCE				<b>REPORTING PERIOD:</b> 1-Jun-02 thru 30-Jun-02						<b>PROJECT NUMBER:</b> 99-E-334			
<b>PARTICIPANT NAME AND ADDRESS:</b> Brookhaven National Laboratory Brookhaven, NY				<b>BCWS PLAN DATE:</b> October 1999						<b>START DATE:</b> October 1998			
										<b>COMPLETION DATE:</b> November 2006			
WORK BREAKDOWN STRUCTURE	CURRENT PERIOD					CUMULATIVE TO DATE					AT COMPLETION		
	Budgeted Cost		Actual Cost of Work Performed	Variance		Budgeted Cost		Actual Cost of Work Performed	Variance		Budgeted	Revised Estimate	Variance
	Work Scheduled	Work Performed		Schedule	Cost	Work Scheduled	Work Performed		Schedule	Cost			
1.1.3 Rings System Development	7.4	7.4	6.01	0.0	1.4	5,091.8	5,091.8	5,112.9	0.0	(21.2)	5,115	5,115	0.0
1.5 Ring & Transfer Line System	1,863.667	1,940.032	2,159.249	76.4	(219.2)	51,685.0	51,736.6	52,598.7	51.6	(862.0)	113,174	113,174	0.0
1.5.1 HEBT (High Energy Beam Transport) Systems	201.3	153.6	140.2	(47.7)	13.4	4,698.2	4,366.6	4,278.5	(331.6)	88.1	10,081	10,081	0.0
1.5.2 Injection Systems	168.0	226.0	228.7	58.0	(2.7)	3,876.6	4,135.9	4,127.5	259.3	8.4	9,151	9,151	0.0
1.5.3 Magnet Systems	340.5	363.14	570.4	22.7	(207.2)	9,772.8	9,636.5	10,028.1	(136.3)	(391.6)	17,013	17,013	0.0
1.5.4 Power Supply System	13.3	11.7	23.8	(1.6)	(12.2)	922.2	916.6	1,002.9	(5.6)	(86.2)	3,524	3,524	0.0
1.5.5 Vacuum System	219.3	376.0	214.6	156.8	161.4	4,037.7	4,439.1	4,477.3	401.4	(38.2)	9,732	9,732	0.0
1.5.6 RF System	173.2	148.5	225.4	(24.7)	(76.9)	5,584.7	6,075.7	6,006.7	491.0	69.0	12,107	12,107	0.0
1.5.7 Ring Systems Diagnostic Instrumentation	172.1	123.3	193.8	(48.8)	(70.6)	5,586.4	5,364.5	6,077.5	(221.9)	(712.9)	14,374	14,374	0.0
1.5.8 Collimation and Shielding	36.9	27.8	48.6	(9.1)	(20.8)	1,674.2	1,476.0	1,477.3	(198.2)	(1.4)	3,418	3,418	0.0
1.5.9 Extraction System	59.1	53.5	74.4	(5.7)	(21.0)	1,492.2	1,440.8	1,493.7	(51.4)	(52.9)	6,144	6,144	0.0
1.5.10 RTBT (Ring to Target Beam Transport) System	182.5	159.0	128.8	(23.5)	30.2	2,724.0	2,568.8	2,442.7	(155.2)	126.1	7,342	7,342	0.0
1.5.11 Cable	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7	0.0	0.0	0.7	0.7	0.0
1.5.12 Technical Support	297.6	297.6	310.4	0.0	(12.9)	11,315.5	11,315.5	11,185.8	0.0	129.6	20,287	20,287	0.0
WBS SUBTOTAL	1,871.0	1,947.4	2,165.3	76.4	(217.9)	56,776.8	56,828.4	57,711.6	51.6	(883.2)	118,289		
UNDISTRIBUTED BUDGET													
SUBTOTAL	1,871.0		2,165.3			56,776.8		57,711.6			118,289		
MANAGEMENT RESERVE													
TOTAL	1,871.0		2,165.3			56,776.8		57,711.6			118,289		
RECONCILIATION TO CONTRACT BUDGET BASE													
DOLLARS EXPRESSED IN:			SIGNATURE OF PARTICIPANT'S PROJECT DIRECTOR:								DATE:		
THOUSANDS			Jie Wei								July 22, 2002		

# 1.5 Performance Measurement Chart

K Dollars



Months

<span style="color: darkgreen;">—●—</span> Cum Planned BA	74,034	74,034	74,034	73,034	73,034	73,034	73,034	73,034	73,034	73,034	73,034	73,034
<span style="color: red;">—▲—</span> Cum Authorized BA	46,034	49,806	49,806	57,806	57,806	57,806	72,947	72,931	72,931			
<span style="color: blue;">—●—</span> Cum Actual BA	45,796	46,801	47,788	49,500	51,402	54,943	57,427	62,496	64,584			
<span style="color: magenta;">—x—</span> Cum BCWS	41,443	39,429	41,061	42,563	44,212	46,288	48,045	49,821	51,685	53,778	55,996	63,941
<span style="color: cyan;">—◆—</span> Cum BCWP	38,670	40,079	41,914	43,553	44,840	46,433	47,079	49,797	51,736.6			
<span style="color: darkgreen;">—■—</span> Cum ACWP	37,521	39,429	41,181	42,722	44,326	46,140	48,353	50,439	52,599			